Students are given objects of the same size and shape but with differing masses. The students are asked to drop the objects from the same height and find the relationship between the drag force and terminal velocity. The magnitude of the drag force is proportional to objects velocity, Fd = -bv. The data is recorded in the table below.

|  |  |  |
| --- | --- | --- |
| Object | Mass(g) | Terminal Velocity(cm/s) |
| 1 | 10 | 12 |
| 2 | 20 | 27 |
| 3 | 30 | 35 |
| 4 | 40 | 48 |
| 5 | 50 | 63 |

a) i) Draw a free body diagram immediately following release 4 points

ii) Draw a free body diagram once the object has reached 2 points forces

terminal velocity 2 points for direction

Label all forces with appropriate length vectors in terms of b,v, m, g.

b) Plot the appropriate data points and include a best fit line with slope.

4 points

1 for points

1 for line

1 for slope

1 for appropriate scale

c) Plot representative acceleration vs time graph for the object. Assume that down is the positive direction. Label all appropriate values. 3 points

1 for Initial value

1 point for asymptote

1 point for shape

d) Based on the plotted data, find the value of b with proper units. 3 points

1 point g/b

1 point calculation

1 point for uints

e) Write the differential equation of motion for the falling object. 1 point

mg-bv = m(dv/dt)